

Introduction to ecology

Explanations

Proximate answer: the immediate, mechanistic cause of a phenomenon (i.e. how it happens)

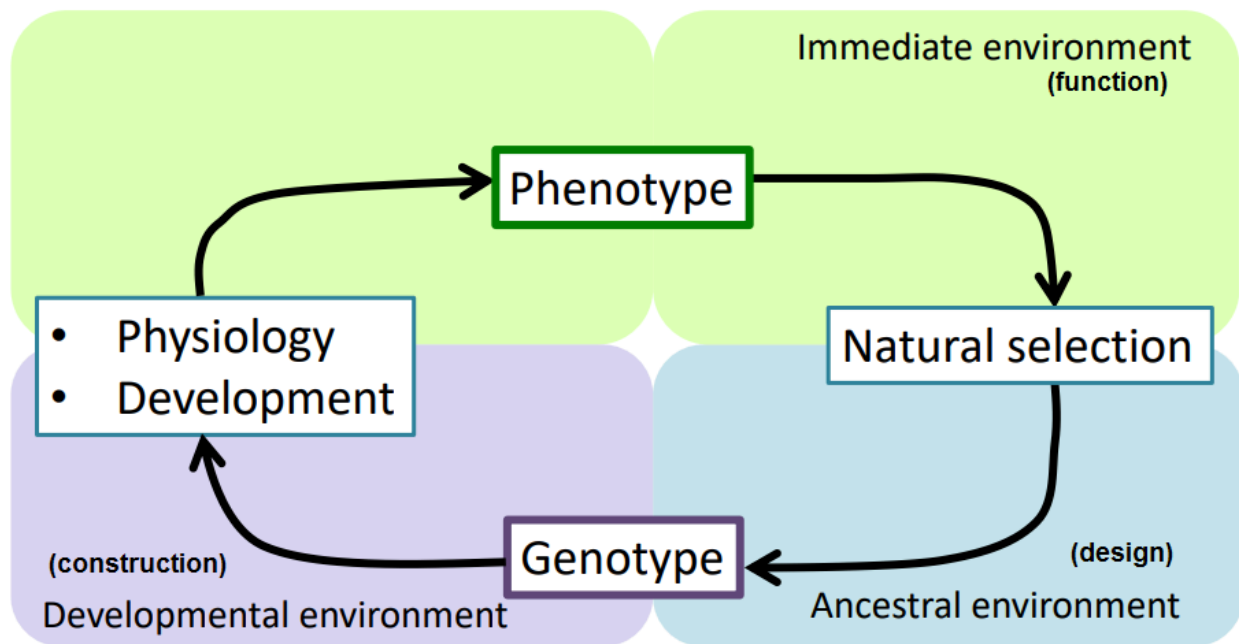
Ultimate answer: reason that trait/phenomenon is thought to have evolved (i.e. why it happens)

Behaviour = Genes + Ecology + Evolution

- Heritable variation in behaviour
- Fitness can depend on social environment

Phenotype = Genotype + Environment

In order to be an **adaptation**, behaviour must **be heritable** and **increase fitness** in environment



Community ecology

Group behaviour:

Tragedy of the commons

Prisoner's dilemma

Maintaining cooperation in prosocial species:

- Create opportunities for reciprocity
- Identify as one team, maintain trust
- Make sure everyone has chance to win

- Punish cheaters
- Make others aware of what is at risk

Intraspecific interactions

(within a single species)

- Cooperative (+/+)
- Competitive (-/-)
- Exploitative (+/-)
 - Cheating

Interspecific interactions

(between different species)

- Mutualistic (+/+)
- Competitive (-/-)
- Exploitative (+/-)
 - Parasitism
 - Predation

Species interactions

- Mutualism (+/+)
- Predation (+/-)
- Competition (-/-)
- Amensalism (-/0)
- Commensalism (+/0)

Intraspecific = interactions are between **conspecifics** (members of the same species)

Interspecific = interactions are between **heterospecifics** (members of different species)

Distribution of species

- Dispersal (not related to reproductive success)
- Abiotic factors
 - Climate (seasonal variation in temperature, humidity, etc.)
- Biotic factors
 - Resource distribution (habitat, producers, prey, etc.)
 - Species interactions (competition, predation, etc.)

Niches

How the organism interacts with the environment, eg habitat, resources, interactions

Niche differentiation = competing species inhabit different niches

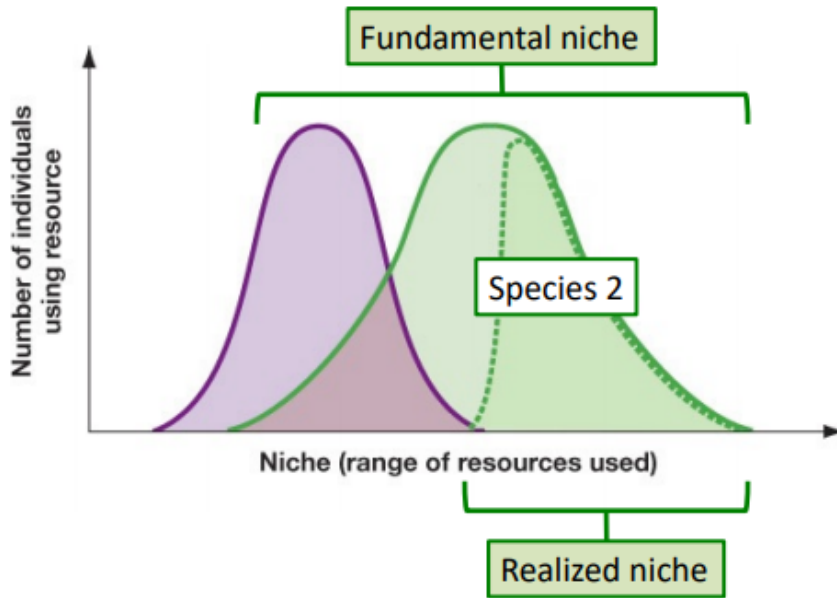
- Different location/timing
- Different resources
- Using resources in different ways

Fundamental niche

- Full range of resources/conditions a species is able to use/tolerate in the absence of competition (and/or other negative interactions)

Realized niche

- Range of resources a species is able to use in the presence of competitors

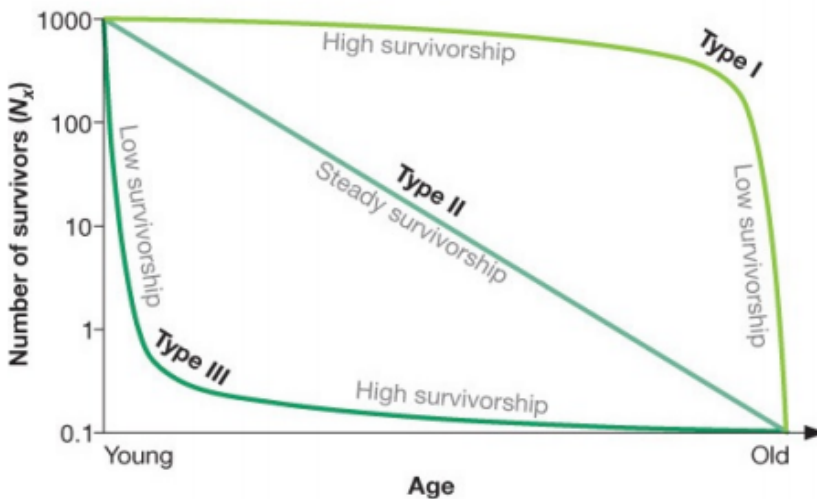
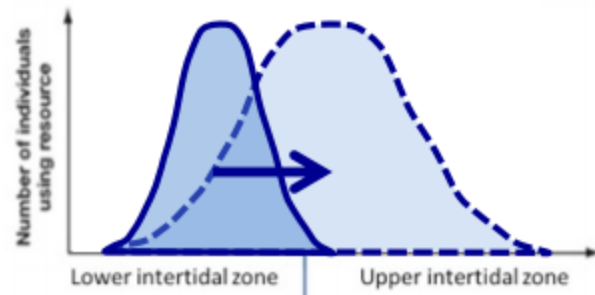


- If weaker individuals can attain **higher fitness** by moving to a new location, or by using different resources (new realized niche), they do so

- If they cannot do so, they become **extinct**

Higher competition between species = lower fitness

Lower intraspecific competition = higher fitness



Survivorship curves

Late loss (Type I)

Die old

Constant loss (Type II)

Die randomly Imao

Early loss (Type III)

Dead fish babies

Principle of Competition Exclusion: “Complete competitors cannot coexist”

No two species can occupy exactly the same niche in the same habitat at the same time

- If niches of two species overlap completely, one species will always have a (slight) advantage
- Eventually, the stronger species will outcompete the weaker

Population Growth Rates

Per capita growth rate = r

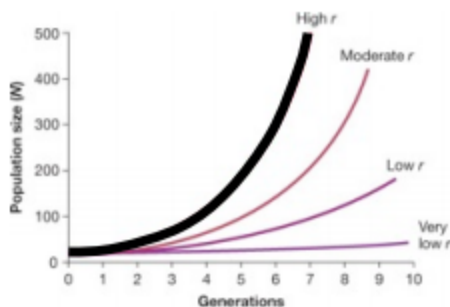
- Captive population (2012):
 - 13 adult owls
 - Three owlets born, two died
- Estimate the per capita growth rate for the captive owl population.



$$r = \frac{\text{birth rate (per owl)} - \text{death rate (per owl)}}{\text{Population size}}$$

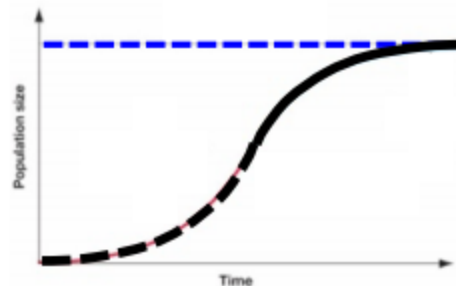
- $(3 - 2)/13 = 0.077$ OR
- $(3 - 2)/(13 + 1) = 0.071$?
^pop. AFTER factoring in births and deaths

Turns out, the average of the two r is the most accurate:
Actual $r = 0.074$



Exponential growth:

- r is constant
- r is density-independent



Logistic growth:

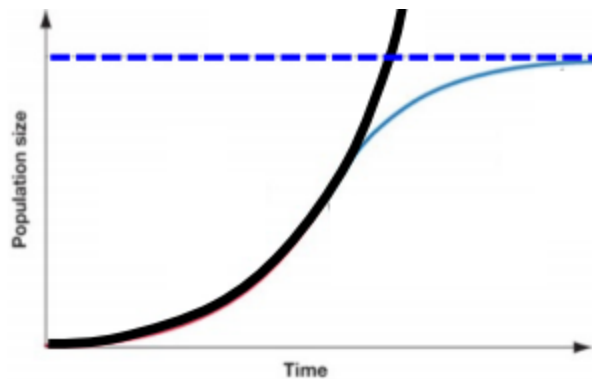
- r is decreasing to 0
- is density-dependent

r = growth rate

Intrinsic per capita growth rate (r_{max}): Rate at which population grows when it's not limited
 -Varies between species (due to time to sexual maturity, births per mating, etc)

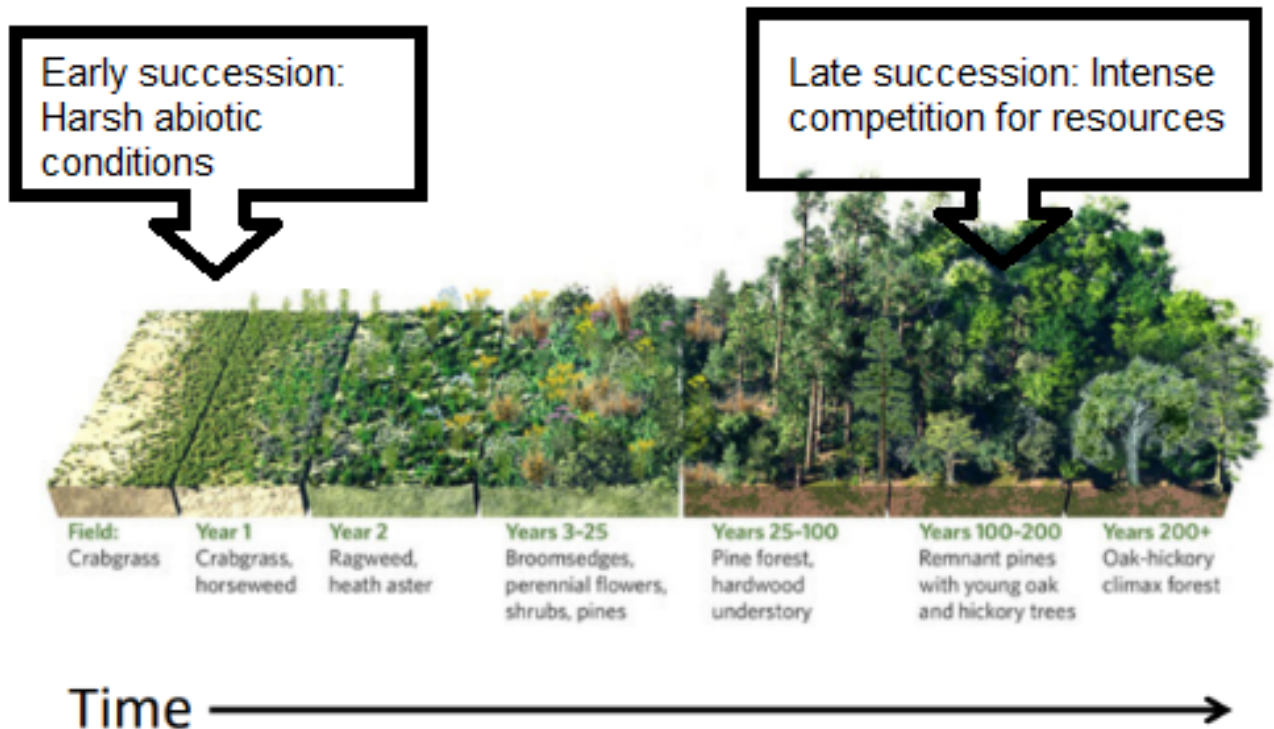
Limiting factors:
 Competition over resources*
 Predation*
 Disease*
 Environmental disasters

*Related to population density
 (AKA factors of **carrying capacity**,
 creates horizontal asymptote)



Ecological disturbances \triangleq any event that removes biomass from a community
Abiotic factors most important in determining the composition of a community immediately following a disturbance, due to lower density \rightarrow lower interactions \rightarrow less competition

Ecological succession \triangleq development of a community



*late succession/climax communities not "end goal", as they're unable to sustain themselves indefinitely. Due to frequency of disturbances, communities cycle through succession.